# NOvA-ART - Bug # 1958: lack of neutron induced hits in NOvA

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| **Status:** | New | **Priority:** | Normal |
| **Author:** | Robert Hatcher | **Category:** | |
| **Created:** | 10/03/2011 | **Assigned to:** | |
| **Updated:** | 10/03/2011 | **Due date:** | |
| **Subject:** | lack of neutron induced hits in NOvA | | |
| **Description:** | I've tried to make our MC to scatter low momentum neutrons. As I sent yesterday Steve and I saw hits for antineutrons but not for neutrons in the single particle generator.<br><br>I've checked that we use the QGSP_BERT Physics List which from the description (http://geant4.cern.ch/support/proc_mod_catalog/physics_lists/referencePL.shtml) is for high energy hadrons. In my test release I changed the list in G4BASE/G4Helper.cxx from QGSP_BERT to LHEP and it scatters neutrons.<br><br>It seems that LHEP or something similar is more appropriate for nova as we are obviously in low energy region. | | |

## History

**10/03/2011 11:55 am - Robert Hatcher**

*- % Done changed from 0 to 10*

I asked about this at my CD/FPE/DSG group meeting and Hans Wenzel spoke up with some historical info about neutrons in G4. Apparently there used to be two bugs in G4, one in the physics of neutron interactions and one having to do with how the physics was integrated into the "physics lists". He thought both had been fixed, but noted it is possible that the 2nd (enabling in all the appropriate physics lists) wasn't right.

bq. in our case (2008) the problem was a bug in G4NeutronInelasticCrossSection (see below) but that was fixed in geant 4 quite a while ago. The last discussion on hypernews
http://hypernews.slac.stanford.edu/HyperNews/geant4/get/hadronprocess/1186.html
it turned out that the process was actually not included in the physicslist. So that would be my first guess.

There was also some discussion about the appropriate physics list. QGSP_BERT is what NOvA is currently hard-coded to use. Possible alternatives are LHEP and SHIELDING. NOvA sits in a odd energy region, especially with the tails that go out to 25-30GeV. It was suggested that, if available, we use *_HP versions of these (HP=neutron high precision). One needs to carefully look at these lists to see what's the configuration for neutrons. NOvA is also currently using G4 v4_9_4_p01; our default choice might need updating when we move to v4_9_5 (which is due out in November).

**10/03/2011 05:04 pm - Robert Hatcher**

*- % Done changed from 10 to 20*

Using CVS HEAD code as of now (for @G4Base@ and @g4nova@ packages) one can configure which physics list to use via the _fcl_ file. See https://cdcvs.fnal.gov/redmine/projects/novaart/wiki/Running_NOvA_Simulations#Producing-FLSHits-using-the-Geant4-Simulation